

**FINAL INTERIM
SITE-SPECIFIC TECHNICAL REPORT
FOR THE EVALUTION OF THERMATRIX GS
SERIES FLAMELESS THERMAL OXIDIZER FOR
OFF-GAS TREATMENT OF TRICHLOROETHENE
VAPORS AT AIR FORCE PLANT 4
FORT WORTH, TEXAS**

AUGUST 1996

Distribution is unlimited; approved for public release

**ENVIRONMENTAL SERVICES OFFICE
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE (AFCEE)**

**FINAL INTERIM SITE-SPECIFIC TECHNICAL REPORT
FOR THE
EVALUATION OF THERMATRIX GS SERIES FLAMELESS
THERMAL OXIDIZER FOR OFF-GAS TREATMENT OF
TRICHLOROETHENE VAPORS AT AIR FORCE PLANT 4
FORT WORTH, TEXAS**

August 1996

**by
Steven R. Archabal, Douglas C. Downey, and Peter R. Guest
PARSONS ENGINEERING SCIENCE, INC.
DENVER, COLORADO**

**for
U.S. AIR FORCE
CENTER FOR ENVIRONMENTAL EXCELLENCE
BROOKS AIR FORCE BASE, TEXAS**

This document was prepared for the United States Government by Parsons Engineering Science, Inc. In no event shall either the United States Government or Parsons Engineering-Science, Inc. have any responsibility or liability for any consequences of any use, misuse, inability to use, or reliance upon the information contained herein, nor does either warrant or otherwise represent in any way the accuracy, adequacy, or applicability of the contents hereof.

TABLE OF CONTENTS

	<u>Page</u>
1.0 Introduction	1
1.1 Project Description	1
1.2 Site Background.....	1
1.3 Test Objectives	2
2.0 Pilot Test Design.....	3
2.1 Thermatrix Flameless Thermal Oxidation System	3
2.2 Vendor's Statement of System Capabilities	3
2.3 Regulatory Approval	5
3.0 Field Demonstration Results	6
3.1 Summary of Initial Site Conditions	6
3.2 Site-Specific Regulatory Approval and Requirements.....	6
3.3 Test Conditions	8
3.4 Observed Performance.....	8
3.5 Problems Encountered	8
4.0 Summary	9
4.1 Technology Performance	9
4.2 Cost	9
4.3 Application of Full-Scale Design	9
5.0 References.....	10

LIST OF TABLES

<u>No.</u>	<u>Title</u>	<u>Page</u>
3.1	Results of Baseline Soil Gas Survey	7

LIST OF FIGURES

<u>No.</u>	<u>Title</u>	<u>Page</u>
2.1	SVEPP and FTO Trailer Unit	4

TABLE OF CONTENTS (Continued)

- APPENDIX A PIPING AND INSTRUMENTATION DIAGRAM (P&ID)**
- APPENDIX B TNRCC STANDARD EXEMPTION REGISTRATION AND
CONCURRENCE WITH EXEMPTION FROM
PERMITTING PROCEDURES**
- APPENDIX C FTO SYSTEM KNOXVILLE REPAIR AND
MODIFICATIONS**

PREFACE

Parsons Engineering Science, Inc. (Parsons ES) was contracted by the Air Force Center for Environmental Excellence (AFCEE) Technology Transfer Division (ERT) to perform a technology demonstration at Air Force Plant 4, Fort Worth, Texas. The work was performed for AFCEE/ERT under Contract Number F41624-94-D-8136, Delivery Order 28.

Key AFCEE/ERT personnel:

Jim Gonzales - Project Manager

Key Parsons ES personnel:

Steven R. Archabal - Site Manager

Douglas C. Downey - Technical Director

Peter R. Guest - Project Manager

1.0 INTRODUCTION

1.1 Project Description

A technology demonstration was designed by Parsons Engineering Science, Inc. (Parsons ES) to determine the applicability of using flameless thermal oxidation (FTO) to treat extracted chlorinated volatile organic compound (VOC) soil vapors, primarily trichloroethene (TCE). The soil vapor extraction (SVE) and treatment demonstration was to be performed at Building 181, Air Force Plant 4 (AFP 4), in Fort Worth, Texas. Building 181 was previously investigated by other contractors to characterize the effects of subsurface solvent releases that were detected in 1991.

This FTO treatment technology demonstration was attempted at Site 181 from 16 March through 30 April, 1996, as part of an ongoing innovative technologies evaluation program sponsored by the US Air Force Center for Environmental Excellence (AFCEE) in order to promote cost-effective vapor treatment technologies at fuel- and solvent-contaminated sites. The technology demonstration was to have been performed in accordance with the *Final Work Plan for the Evaluation of Flameless Thermal Oxidation at Air Force Plant 4 (AFP 4), Fort Worth, Texas* (Parsons ES, 1996), as approved by the Air Force and regulatory agencies.

A series of equipment malfunctions and programmable logic controller errors precluded successful pilot testing of the Thermatrix, Inc. FTO treatment system at AFP 4. The purpose of this report is to document the problems encountered during system startup and attempted operation at Site 181, and to provide available information on site conditions, regulatory requirements, initial test conditions, and the status of system repairs. Currently it is uncertain whether or not a demonstration of the FTO treatment system will be conducted at Site 181 once the Thermatrix unit is repaired. If a demonstration is completed, a revised site-specific technical report will then be submitted at the conclusion of the test. To preserve the site-specific technology performance evaluation report format approved by AFCEE, this report retains section headings for which data are not currently available. If an FTO demonstration is completed at Site 181, AFP4, at a later date, a revised version of this report will be submitted with appropriate information provided under each section.

1.2 Site Background

Building 181 is located in the southwestern corner of the assembly/parts plant at AFP 4. Historically, parts degreasing operations were performed in the northeastern corner of Building 181.

In May 1991, plant personnel noted that an excessive amount of solvent (TCE) was required to fill one of the 1,500-gallon degreasing tanks (tank 544). Shortly thereafter, the tank was discovered to be leaking. Additionally, several surface spills had been reported within Building 181, although the exact volumes and locations of the spills were not available in the review material [Environmental Science & Engineering, Inc. (ESE), 1994a]. On July 15, 1991, degreasing storage tanks 534 and 544 were removed from service [Hargis & Associated, Inc. (Hargis), 1992].

Based on the previous site investigations, the highest concentrations of contamination in the subsurface were detected near the former degreasing tanks in Building 181 (Hargis, 1992). In November 1993, a soil vapor extraction pilot plant (SVEPP) was installed by ESE to conduct a 3-month treatability test to determine the soil air permeabilities near each of eight SVE wells, the radius of influence around each extraction well and the concentrations of VOCs (primarily TCE) in the extracted soil gas (ESE, 1994b).

Based on the results of the SVEPP test, significant TCE concentrations remained at several of the extraction wells and monitoring point locations following the 90-day test period. During the SVEPP test, the extracted soil vapor was treated using granular activated carbon (GAC) prior to being discharged to the atmosphere. Because the loading capacity of GAC is relatively low when treating TCE (typically 10 percent at 90-percent relative humidity), the cost of operating the GAC system at this site is expensive. A more cost-effective vapor treatment technology for the Building 181 site is desired. A more detailed description of the nature and extent of site contaminants is provided in the *Work Plan for the Evaluation of Flameless Thermal Oxidation at AFP 4, Forth Worth, Texas* (Parsons ES, 1996).

On September 20, 1995, Parsons ES received formal notice-to-proceed from the Air Force to evaluate the FTO vapor-phase treatment technology and to support air emissions conformity. Four Air Force installations were identified for testing, including Building 181 at AFP 4 in Forth Worth, Texas. Parsons ES subcontracted with Thermatrix, Inc. (Thermatrix) to provide the FTO treatment system to be used during the demonstration. Thermatrix is an Air Force-directed subcontractor for this technology evaluation.

1.3 Test Objectives

The FTO treatment system was designed to be used at a variety of Air Force sites exhibiting varying site conditions. The system design is capable of treating a range of contaminant types (both chlorinated and non-chlorinated organic vapor streams) at flow rates ranging from 20 to 120 standard cubic feet per minute (scfm). Its mobility (trailer-mounted) and automated operation (programmable logic controlled (PLC)) are other positive advantageous design features.

A thorough cost and performance evaluation of the FTO system was planned during a 90-day period at Building 181, AFP 4. The technology evaluation objectives were to examine the following parameters:

- Extracted vapor VOC destruction efficiency;
- Operating costs;
- Impacts on destruction efficiency and costs under varying influent VOC vapor concentrations and flow rates;
- Overall system reliability and maintainability; and
- Other useful operating parameters as determined by the evaluation team.

2.0 PILOT TEST DESIGN

2.1 Thermatrix Flameless Thermal Oxidation System

The FTO system was designed to extract and treat contaminated vapors at flow rates between 20 to 120 scfm, and to reduce the influent contaminant concentration by not less than 99.99 percent. Vacuum is produced in the subsurface using multiple vapor extraction wells and an extraction blower. Extracted soil vapors, injected at a regulated flow rate, pass through a premixing chamber, and then into the reaction bed where complete oxidation occurs at approximately 1,800 degrees Fahrenheit (°F).

When the vapor stream reaches oxidation temperature, organic compounds react to form carbon dioxide, water, and (in the case of chlorinated hydrocarbons) hydrochloric acid (HCl), releasing heat that is then reabsorbed by the ceramic matrix of the reaction bed. The system also contains an effluent caustic scrubber that is designed to remove at least 99.5 percent of HCl from the reactor exhaust at the maximum design loading rate of approximately 3.0 pounds per hour of HCl. The GS Series FTO used at this site allows for a single pass of the extracted vapors through the oxidizer. A complete process flow schematic of the FTO system is shown in the piping and instrumentation diagrams (P&IDs) presented as Figures A.1a and A.1b in Appendix A.

The FTO system is self-contained and skid-mounted on a trailer with a dedicated electrical distribution system. The system is designed to operate within single-circuit, 480-volt, 3-phase, 100-amp electrical power limitations. The system is enclosed to provide weather protection for system components that could be affected by temperature, moisture, and windblown particulates. At AFP 4, Building 181, the FTO system was connected to the existing pipe manifolds used in the earlier SVEPP test. Parsons ES was able to use the metered water and electrical supply currently installed at the site (Figure 2.1).

2.2 Vendor's Statement of System Capabilities

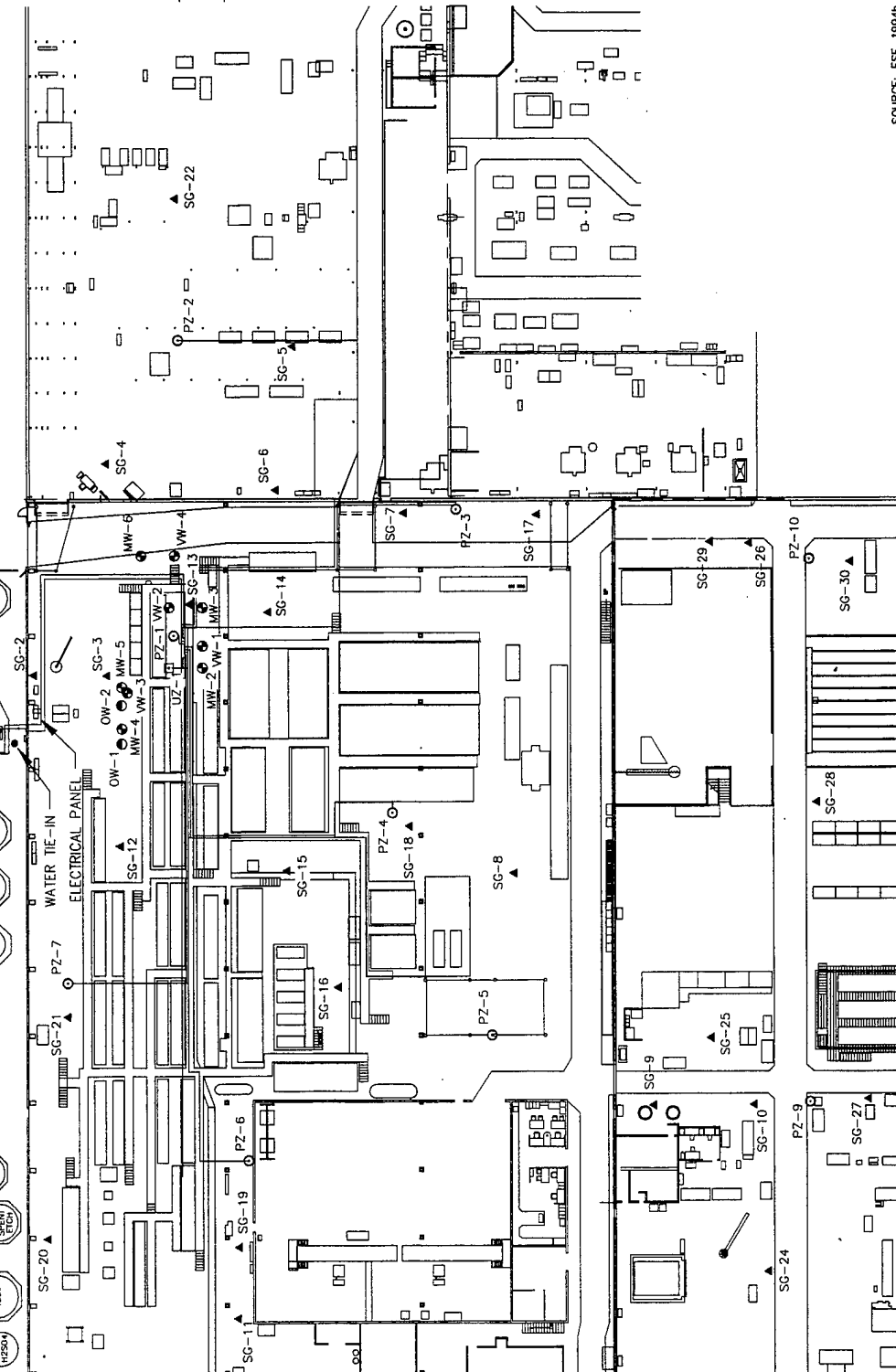
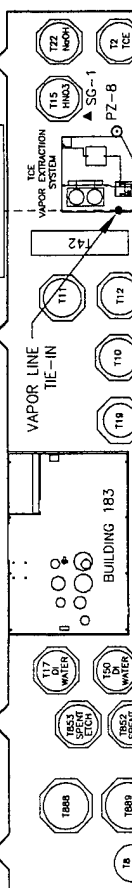
Thermatrix manufactures a patented FTO treatment technology that incorporates a corrosion resistant ceramic matrix and oxidizer material that are immune to moisture and acid, non catalytic, and have a temperature rating of up to 2,500°F.

Based on information provided by Thermatrix, a series of tests have demonstrated the inherent safety of the FTO (Meltzer, 1992). Conditions considered to be worst-case from a safety standpoint were investigated by Thermatrix. Flow rates and concentrations of VOCs (as propane) were varied over wide ranges. The different flow rates through the unit resulted in residence times ranging from 0.15 second to 10 minutes, and the VOC concentrations [1000 to 160,000 parts per million, volume per volume (ppmv)] spanned the flammability range from 5 percent of the lower explosive limit (LEL) to 170 percent of the upper explosive limit (UEL). Under all test conditions, no flashback or detonation occurred.

In many flame-based devices, some of the soil vapor can bypass the flame zone. This bypassing causes incomplete contaminant destruction and can result in the formation of products of incomplete combustion (PIC). The configuration of the flameless oxidizer is intended to eliminate these problems. The reaction zone covers

INDUSTRIAL ACCESS ROAD

FTO TRAILER UNIT



LEGEND

- UZ-1
 - PZ-1
 - OW-1
 - VW-4
 - MW-6
 - ▲ SG-18
 -
 -
- DEEP EXTRACTION WELL
 - SHALLOW (PERCH ZONE) EXTRACTION WELL
 - OBSERVATION WELL
 - PERCHED ZONE MONITORING WELL
 - MONITORING WELL
 - SHALLOW SOIL GAS MONITORING PROBE
 - SVEPP SYSTEM PIPING (PERMANENT 2 INCH DIA FIBERGLASS)
 - FTO DEMONSTRATION PIPING

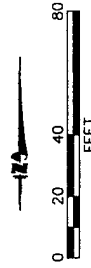
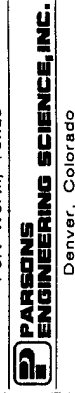


FIGURE 2.1

SVEPP AND FTO TRAILER UNIT

FTO Demonstration
Air Force Plant 4
Fort Worth, Texas



SOURCE: ESE, 1994b

the entire cross-section of the matrix, and all of the vapor must pass through the reaction zone before it exhausts from the oxidizer as CO₂, H₂O, and HCl.

Complete conversion of the VOCs to harmless byproducts and HCl occurs rapidly in the reaction zone of the FTO unit because of the intimate premixing with air and the heat transfer properties of the ceramic matrix. Previous testing by Thermatrix has shown that a residence time of 0.15 second in the FTO can result in greater than 99.99 percent destructive removal efficiency (DRE). The flameless oxidizer included in the treatment system has a nominal residence time of 0.5 second (Thermatrix, 1992). There is no need for additional residence time.

According to Thermatrix, the FTO technology is capable of processing batch or variable-flow vapors or fumes because of the heat retention and radiative properties of the ceramic matrix design. It can handle VOC vapor spikes above nominal capacity, or a complete interruption in vapor flow, and remain functionally on-line with no upset condition or safety concerns (as could occur with a flame blow out). Turndown for batch or variable-flow fumes is generally limited by the span of the instruments or auxiliary equipment (e.g., blowers or flow control valves) used in the flameless oxidation system.

Performance tests have demonstrated the 99.99-percent and greater DRE of the FTO system for a wide variety of compounds, including chlorinated hydrocarbons (Meltzer, 1992; Thermatrix, 1992). Tests also have measured typical NO_x emissions of less than 2 ppmv and carbon monoxide emissions of less than 10 ppmv. Single-component and mixed organic vapor streams have been successfully treated, including benzene, carbon tetrachloride, dichloromethane, ethyl chloride, isopropanol, methane, paint solvent mixtures, propane, and toluene. These compounds are chemically representative of many of the types of VOCs, including chlorinated aliphatic hydrocarbons (CAHs) often found in industrial fumes. The test procedures, analytical methods, and performance results are detailed in a separate report (Thermatrix, 1992).

2.3 Regulatory Approval

Acceptance of Thermatrix FTO systems by regulatory agencies has been widespread, including federal EPA, state, and local air quality districts. The following states have permitted Thermatrix FTO systems to date:

California	Georgia	Idaho
Indiana	Louisiana	Maryland
Massachusetts	Michigan	Mississippi
Montana	New Jersey	New York
North Carolina	Pennsylvania	South Carolina
Tennessee	Texas	

PURUS also anticipates permits in Germany, Switzerland, and Puerto Rico in 1995. Also, Canada, England, and France with projects in progress in the Netherlands and Taiwan.

3.0 FIELD DEMONSTRATION RESULTS

3.1 Summary of Initial Site Conditions

Prior to startup of the FTO system at AFP 4 Building 181, initial soil gas sampling was conducted to establish the baseline soil gas VOC conditions at the site. Results from the baseline soil gas survey are presented in Table 3.1. Figure 2.1 identifies the piping, vapor monitoring points, SVE wells, and location of the FTO system used during the initial startup of the demonstration.

Soil gas samples were initially collected by purging the well casing volume the equivalent of 3 to 5 times, based on the well diameter and depth. Following the purge, a sample was collected in a Tedlar® bag and analyzed in the field using a portable, handheld photoionization detector (PID) instrument. A Photovac-MicroTip® PID was used to screen the soil gas samples. Because the MicroTip® linear calibration range is 0 to approximately 2,000 ppmv, it was sometimes necessary to dilute the sample several times to achieve a reading within the instrument's linear range.

Additionally, the MicroTip®, equipped with a 10.6-electron-volt (eV) lamp, has been factory calibrated against various chemical compounds. Based on the known concentration of the compound, a specific relative response factor (RRF) was assigned when using the standard isobutylene calibration gas. Photovac has assigned a RRF of 0.6 for TCE. Therefore, an RRF of 0.6 was used to adjust the direct soil vapor readings collected at Building 181 (see Table 3.1). An example of this correction calculation is provided below:

Instrument reading X dilution factor (DF) X RRF = estimated TCE concentration

Example: 620 ppmv X 3 (DF) X 0.6 (RRF) = 1,116 ppmv (TCE)

To ensure that an accurate dilution factor was obtained, a laboratory-grade, calibrated 1.5-liter syringe was used during this process.

3.2 Site-Specific Regulatory Approval and Requirements

To ensure compliance with the Texas Clean Air Act as implemented by the Texas Natural Resource Conservation Commission (TNRCC), Parsons ES, in conjunction with AFP 4 and AFCEE, prepared the necessary documentation to obtain approval to conduct the pilot-scale demonstration of the FTO system at Building 181, AFP 4, Fort Worth, Texas. In order to expedite the approval process, Parsons ES completed the necessary forms to request a TNRCC Standard Exemption 68 permit pertaining to the FTO demonstration. The existing SVE and groundwater treatment systems installed at Building 181 were already registered under a Lockheed Fort Worth Company Standard Exemption Registration. General site information contained in the existing Standard Exemption Registration was used during the preparation of the FTO system Standard Exemption application for the 90-day, pilot-scale demonstration at Building 181, AFP 4. The Standard Exemption Registration, and TNRCC concurrence with the exemption from permitting procedures, are presented in Appendix B.

TABLE 3.1
RESULTS OF BASELINE SOIL GAS SURVEY
(Conducted 3/14 to 3/16/96)
FLAMESLESS THERMAL OXIDATION OFF-GAS TREATMENT DEMONSTRATION
BUILDING 181
AIR FORCE PLANT 4, TEXAS

Location	Photovac-Microtip® PID Reading (ppmv)	Dilution Factor	Estimated TCE Concentration (ppmv) ^{a/}
PZ-1	1,160	3	2,088
PZ-2	570	1	342
PZ-3	185	1	111
PZ-4	1,955	1	1,173
PZ-5	104	1	62
PZ-6	933	1	560
PZ-7	836	1	502
PZ-8	1,605	1	963
PZ-9	72	1	43
PZ-10	123	1	74
PZ-11	175	1	105
UZ-1	1,850	30	33,300
UZ-2	383	1	230
UZ-3	670	1	402
MW-2	1,135	30	20,430
MW-3	1,116	60	40,176
SG-1	1,370	2	1,644
SG-2	620	3	1,116
SG-3	1,962	10	11,772
SG-5	76	1	46
SG-7	460	1	276
SG-8	77	1	46
SG-10	150	1	90
SG-12	1,631	4	3,914
SG-13	1,260	3	2,268
SG-18	1,035	1	621
SG-19	335	1	201
SG-21	210	1	126
SG-30	140	1	84
SG-31	42	1	25

a/ Estimated TCE result is based on the following calculation:

Photovac-MicroTip® reading x dilution factor x 0.6 (Response factor) = TCE result.

3.3 Test Conditions

Appropriate information will be provided in this section if the FTO soil vapor treatment demonstration at Site 181 is completed.

3.4 Observed Performance

Appropriate information will be provided in this section if the FTO soil vapor treatment demonstration at Site 181 is completed.

3.5 Problems Encountered

A series of Thermatrix FTO equipment failures precluded successful completion of the technology demonstration planned for Site 181. Provided below is a chronology of events that occurred from the time the FTO treatment system was delivered to the site on March 13, 1996, until the time it was removed from the site on April 30, 1996.

- The FTO system was delivered to AFP 4, Texas on March 13, 1996.
- Parsons ES completed the required electrical and water tie-ins for the FTO system on the afternoon of March 14, 1996; however, programming problems and equipment failure prevented system startup;
 - The PLC program caused the system to shut down during start up, and
 - The temperature quench was too high, causing the system to shut down.
- On March 23, 1996, the system experienced a backfire within the oxidizer vessel that caused the Kaowool refractory blanket in the crossover duct and oxidizer to shift and loosen, clogging the scrubber packing and spray nozzles within the scrubber system. The cause of the backfire was suspected to be due to a combination of improper propane fuel flow and air flow rate mixture through the oxidizer causing a small explosion or combustion.
- After several days of trying to repair the FTO system on the site, Thermatrix removed the unit from the site on April 4, 1996, and transported it to a fabrication shop in Ft. Worth, Texas to perform repairs and modifications. Primary repairs that were completed in the fabrication shop included:
 - Repair insulation in crossover duct;
 - Install inline basket strainers before the quench and scrubber to remove any insulation that may remain in the system due to the backfire;
 - Complete insulation of caustic tank;
 - Make program changes to the PLC;
 - Install an inline valve on the discharge side of the vacuum blower;
 - Install a drain valve on the propane tank; and

- Install a drain valve on the caustic tank.
- On April 19, 1996, the FTO treatment system was transported from the fabrication shop to AFP 4 and reinstalled at Site 181.
- On April 21, 1996, the FTO treatment system started operating on vapors from the extraction wells. However, the unit had to be shut down after approximately 5 minutes of operation due to improper operation of the caustic solution control valve and large swings in pH control and scrubber flow rates.
- On April 22, 1996, the pH control valve was removed and returned to the manufacturer to be repaired.
- On April 25, 1996, the repaired pH control valve was returned to the site and reinstalled.
- Between April 26 and April 28, 1996, the FTO treatment system did not operate correctly in the run mode due to difficulty controlling the pH level when the caustic solution was added to the system.
- On April 29, 1996, a decision was made by Thermatrix, Inc., Parsons ES, and the Air Force to remove the FTO treatment system from AFP 4 and return it to the Thermatrix, Inc. shop in Knoxville, Tennessee to make necessary repairs to enable the unit to operate successfully.
- On April 30, 1996, Gauger Heavy Haul and Rigging picked up the FTO treatment system at AFP 4 and transported it to Knoxville, TN.

Repairs and modifications were made to the FTO system to address the above-described problems in Thermatrix, Inc.'s Knoxville, Tennessee facility from May 2, 1996 through July 22, 1996. The equipment and operational issues that were addressed by Thermatrix are presented in Appendix C.

4.0 SUMMARY

Appropriate information will be provided in this section if the FTO soil vapor treatment demonstration at Site 181 is completed.

4.1 Technology Performance

4.2 Cost

4.3 Application of Full-Scale Design

5.0 REFERENCES

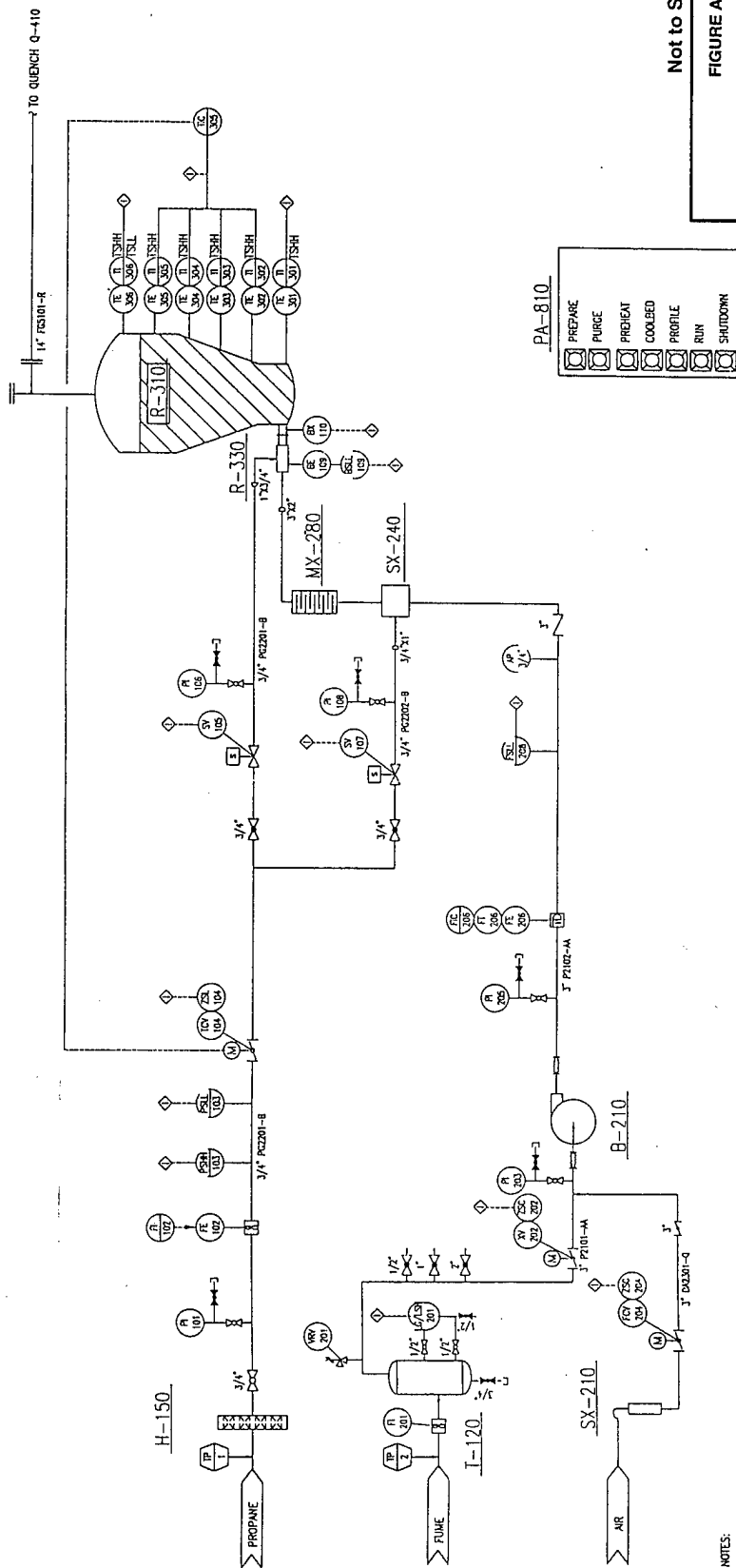
- Environmental Science & Engineering, Inc. (ESE), 1994a. *Final Report Summary of Remediation Projects at Air Force Plant 4 and Carswell AFB*. July.
- ESE. 1994b. *Soil Vapor Extraction Pilot Plant Study, Building 181, Fort Worth Texas*. July.
- Hargis & Associates, Inc., (Hargis). 1992. *Soil and Groundwater Assessment, Building 181, US Air Force Plant 4. General Dynamics, Inc. Fort Worth, Texas*.
- Meltzer, J.S. 1992. "Flashback Testing of Thermatrix ES-60H Oxidizer," Report No. SSR-1628, Fenwal Safety Systems, Inc., Marlborough, MA.
- Parsons Engineering Science, Inc. 1996. *Final Work Plan for the Evaluation of Flameless Thermal Oxidation at Air Force Plant 4 (AFP 4), Fort Worth, Texas*. January.
- Thermatrix Inc. 1992. *Destruction of Organic Compounds in the Thermatrix Flameless Thermal Oxidizer*, San Jose, California.

APPENDIX A

PIPING AND INSTRUMENTATION DIAGRAM (P&ID)

SX-210 I-120 H-150 B-210
 FILTER/SILENCER K.O. POT VAPORIZER/REGULATOR AIR/FUME BLOWER 3" x 3"
 DX-500 A/B DX-510 A/B DX-510 A/B PA-810
 SPARGER STATIC MIXER THERMAL OXIDIZER BURN AND COOL CROSSOVER DUCT CONTROL PANEL

DX-500 A/B DX-510 A/B



Not to Scale

FIGURE A.1a

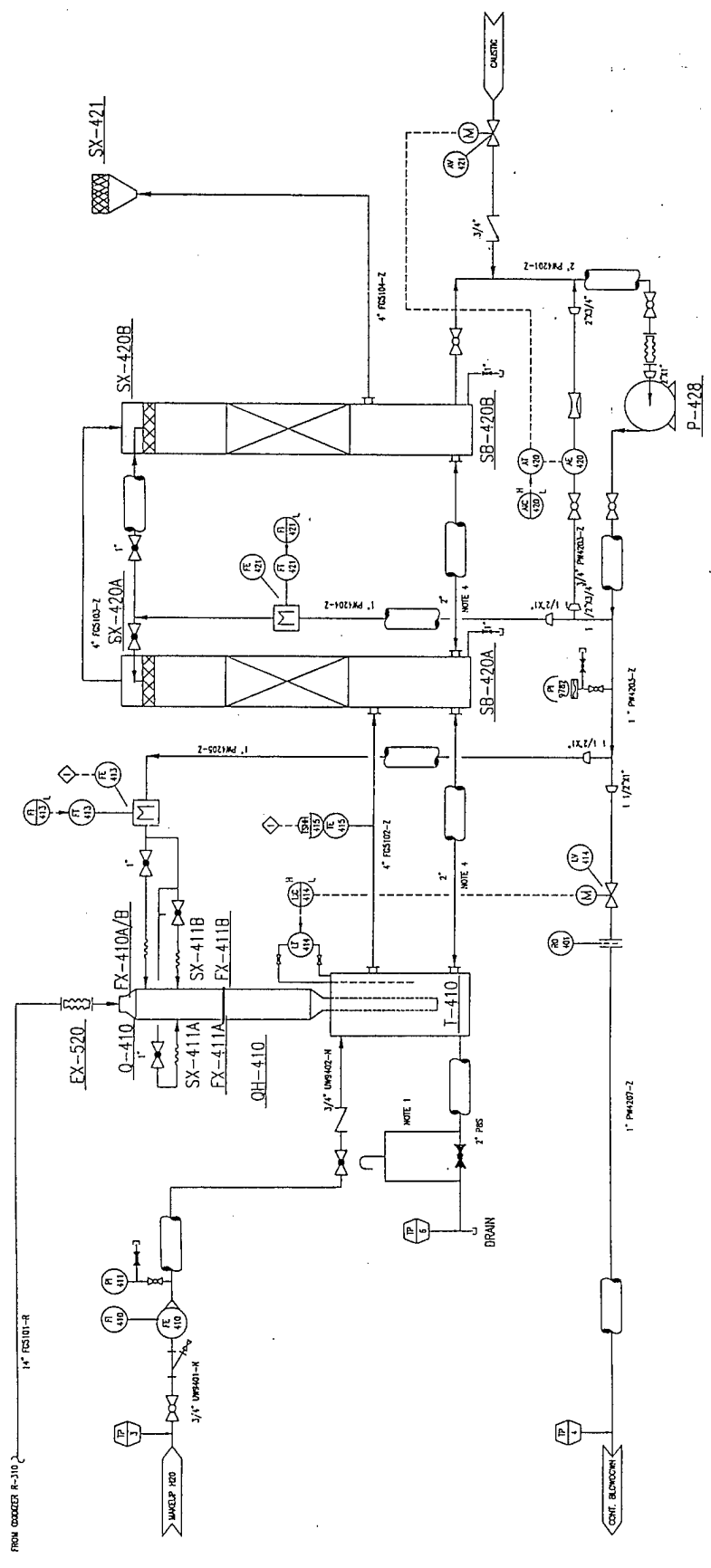
FRONT (INFLUENT) HALF OF FTO PIPING AND INSTRUMENTATION DIAGRAM

FTO Demonstration
 Fire Training Area, FT-002
 Plattsburgh AFB, New York

PARSONS
ENGINEERING SCIENCE, INC.
 Denver, Colorado

- NOTES:
1. AREA CLASSIFICATION IS GENERAL SERVICE
 2. INSTRUMENT AIR IS NOT AVAILABLE
 3. ALARM INDICATIONS ARE PROVIDED FOR ALL SWITCHES
 4. ESD KILLS ALL SMO OPERATIONS

I-410 QUENCH TANK
 Q-410 QUENCH HBR
 EX-520 EXPANSION JOINT
 SX-411A QUENCH NOZZLE
 EX-411A FLEX CONNECTOR
 FX-411B FLEX CONNECTOR
 SX-411B QUENCH NOZZLE
 QH-410 QUENCH DUCT
 SB-420A SCRUBBER
 SB-420B SCRUBBER
 SX-420A SPRAY DISTRIBUTOR
 SX-420B SPRAY DISTRIBUTOR
 P-428 CIRCULATION PUMP
 SX-421 DUSTER



- NOTES:
1. SEE LUG OVERLAP AT HIGH LEVEL.
 2. FLOWMETER FOR THE PUMP.
 3. SYSTEM OF ALL SERVICES IS INDICATED.
 4. CRACKING SURF THE LINE.

Not to Scale

FIGURE A.1b

BACK (EFFLUENT) HALF OF FTO PIPING AND INSTRUMENTATION DIAGRAM

FTO Demonstration
 Fire Training Area, FT-002
 Plattsburgh AFB, New York



**PARSONS
 ENGINEERING SCIENCE, INC.**
 Denver, Colorado

APPENDIX B

**TNRCC STANDARD EXEMPTION REGISTRATION
AND
CONCURRENCE WITH EXEMPTION FROM
PERMITTING PROCEDURES**

LOCKHEED MARTIN

Tactical Aircraft Systems

9 January 1996
ERM-96-017

Ms. Victoria Hsu, P.E.
Director, Permitting
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, Texas 78711-3087

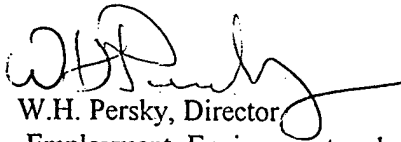
Subject: Flameless Thermal Oxidizer (FTO) Demonstration
TNRCC Account No. TA-0156-K

Dear Ms. Hsu:

The United States Army Corps of Engineers has contracted with Parsons Engineering Science Inc. to demonstrate FTO technology on-site at Air Force Plant No. 4 in Fort Worth, Texas. The unit will be operational for only 90 days and will be used to augment the existing soil vapor extraction system previously authorized as Standard Exemption Registration No. 23558. We believe that this temporary system meets the conditions of Standard Exemption No. 68 for equipment used to treat contaminated groundwater or soil.

As the facility contractor for Air Force Plant No. 4, and on behalf of Parsons Engineering, we submit the Standard Exemption Registration Form PI-7, along with all necessary documentation. This registration has been discussed in detail with Mr. Terry Murphy of your staff. If you have any questions or need additional information, please contact Mr. Scott Fetter at (817) 777-3791.

Sincerely,


W.H. Persky, Director
Employment, Environment and
Safety and Health

WHP:SF:caw

cc: Mr. Jesse Macias, TNRCC Region 4, Fort Worth
Mr. T.C. Michael, City of Fort Worth, Fort Worth



TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

REGISTRATION FORM FOR STANDARD EXEMPTIONS

FORM PI-7

Please mail to: TNRCC, Office of Air Quality, New Source Review Division (MC-162), PO Box 13087, Austin, TX 78711-3087

I. Company Name Parsons Engineering Science, Inc.
(Corporation, Company, Government Agency, Firm, etc.)
Mailing Address 1700 Broadway, Suite 900, Denver, CO 80290
Individual Authorized to Act for Applicant: Name Pete Guest Title Project Manager
Address 1700 Broadway, Suite 900 Telephone (303) 831-8100 Fax (303) 831-8208
Denver, CO 80290

II. LOCATION OF EXEMPT FACILITY (Latitude and Longitude must be to the nearest second):
Name of Plant or Site U.S. Air Force Plant #4
Street Address 1500 Lockheed Boulevard
Nearest City Fort Worth County Tarrant Latitude 32° 46' 05" Longitude 97° 27' 04"
SITE REQUIREMENTS: A. Submit a plot plan to scale of the property showing the location of plant boundaries, plant equipment, and surrounding area.
B. Furnish an area map with a scale showing the facility location relative to highways and towns.

III. TYPE OF FACILITY:
A. Applicable Standard Exemption Number(s) from TNRCC List 68
B. Name of Facility and Company's Facility Number Flameless Thermal Oxidizer (FTO) Demonstration
C. TNRCC Account Identification Number TA-0156K
D. Previous Special Exemption or Permit Number 23558
E. Operating Schedule: Hours/day 24 Days/week 7 Weeks/year 12
F. Proposed Start of Construction 2-15-96 (Date) Operation 3-1-96 (Date)
G. Permanent [] Portable [X]
H. Length of time at this site, if portable 90 Days

IV. PROCESS INFORMATION
Description of Process: Prepare and attach a written description of the exempt process and applicable checklists (when available). The description must be in sufficient detail to indicate that the facility will conform to the specified exemption.

V. EMISSIONS DATA
Furnish a description of the basis for emission rates including fugitives. (Calculations, emission factors, measurement, NSPS, etc.)

Emission Point Number	Name of Source	Name of Air Contaminant	Emission Rate of Each Air Contaminant			
			lb/hr		(90 days) tons/yr	
			Gaseous	Particulate	Gaseous	Particulate
FTO	FTO	Trichloroethylene (TCE)	0.04		0.0432	
FTO	FTO	Hydrogen Chloride (HCl)	0.016		0.0172	

VI. The required copy of the application has been sent to the Regional Office of the TNRCC: ☒ Yes [] No
The required copy of the application has been sent to the Local Programs (if applicable): ☒ Yes [] No

VII. I. Pete Guest (Name) Project Manager (Title)
state that I have knowledge of the facts herein set forth and that the same are true and correct to the best of my knowledge and belief. I further state that to the best of my knowledge and belief, the project will satisfy the conditions and limitations of the indicated exemption. The facility will operate in compliance with all Regulations of the Texas Natural Resource Conservation Commission and with Federal Environmental Protection Agency Regulations governing air pollution.
DATE 12/21/95 SIGNATURE Pete R. Guest

30 TAC CHAPTER 116, RULE §116.211
PERMIT EXEMPTIONS - APPLICABILITY CHECKLIST

This checklist is designed to help you confirm that you meet the general rule for using standard exemptions. Whether or not you use this checklist, your claim must be shown to meet all appropriate general requirements, as well as those in each standard exemption you are claiming.

1. Description of overall activities at this location: Aircraft Manufacturing Plant

2. Are there any numbered air permits under the same account number? ☒ YES ☐ NO

If yes, do any permit conditions prohibit or restrict the use of standard exemptions (§116.211[a][6])? ☐ YES ☒ NO

(1) If yes, which permit numbers: _____

(2) If yes, standard exemptions may not be used or their use must meet the restrictions of the permit. A new permit or permit amendment may be required.

3. Emissions check for this STDX claim (§116.211(a)(1)) (see Note 1)

Calculated Tons Per Year

CO: 0.00 NOx: 0.00 SOx: 0.00 PM: 0.00 VOC: 0.0432 Other: 0.0172(HCI)

Note 1: List all emissions for this project (include point and equipment fugitive emissions from new or modified facilities as well as increases upstream and downstream that result from this project.)

Are SOx, PM, VOC and other emissions shown above each less than 25 TPY? ☒ YES ☐ NO

Are the NOx and CO emissions shown above each less than 250 TPY? ☒ YES ☐ NO

If the answer to either question is "NO," a standard exemption cannot be claimed.

4. Site exemption emissions check (§116.211[a][3]): Are total SOx, PM, VOC and other emissions claimed under standard exemption at the site each less than 25 TPY? ☒ YES ☐ NO

Are total NOx and CO emissions claimed under standard exemption at the site each less than 250 TPY? ☒ YES ☐ NO

If either question is answered "NO," determine if one facility at the property has had public notification and comment as required in Subchapter B or D of 30 TAC 116 or the applicable procedures of Chapter 116 in effect at the time of registration. If public notice has occurred, what permit or standard exemption required this action? _____

If public notice has not occurred, a permit may be required for the proposed facility.

5. Nonattainment Check (§116.211[a][2]): Is the facility located in a nonattainment county/area (see listing below)? ☒ YES ☐ NO

If "NO," skip to paragraph 6.

If "YES," which county/area? Tarrant

Show the actual increases (defined as new allowables minus old actuals - see Nonattainment New Source Review Manual) in emissions, without regard for any decreases, which result from this standard exemption claim for the following pollutants:

NOx: 0.00 VOC: 0.0432 CO: 0.00 PM10: 0.00

Is the site an existing major source? (See §116.012)

☒ YES

☐ NO

Is the modification major? (See §116.012, Table I)

☐ YES

☒ NO

You may be required to provide documentation of nonattainment new source review applicability. If you have determined these requirements apply at your site for this exemption claim, enclose the necessary netting documentation (See Nonattainment New Source Review Manual).

6. Prevention of Significant Deterioration (PSD) Check (§116.211[b]):

An overall emissions rate of 100 (for a named source) or 250 tons per year or more on-site, or a significant modification for any single air contaminant for which a NAAQS has been issued may indicate a need for PSD review under 40 CFR 52. If you have determined that the netting requirements of 40 CFR 52 are triggered by this exemption claim, enclose the necessary documentation.

7. If any EPA New Source Performance Standards (NSPS) or National Emissions Standards for Hazardous Air Pollutants (NESHAPS) are applicable for the facility covered by the exemption(s) claimed (§116.211[a][5]), list them here: None

8. §116.211(c) states "No person shall circumvent by artificial limitations the requirements of §116.110 of this title (covering permitting)." Circumvention by artificial limitations may include:

- (a) dividing a complete project into separate segments to circumvent §116.211(a)(1) limits;
- (b) claiming feed or production rates below the physical capacity of the project's equipment in order to begin constructing facilities before a permit or permit amendment is approved for full scale operations.

Ensure that any exemption claim is free of circumvention by means of artificial limits such as these.

9. If all §116.211 requirements are met, we suggest use of the appropriate standard exemption worksheet(s) or checklist.

NONATTAINMENT AREAS FOR OZONE (VOC OR NOx): Brazoria, Chambers, Collin, Dallas, Denton, El Paso, Fort Bend, Galveston, Hardin, Harris, Jefferson, Liberty, Montgomery, Orange, Tarrant, and Waller Counties for VOC and NOx as precursors to ozone; and, Victoria County for VOC only.

FOR LEAD: Section of Collin County

FOR PARTICULATE MATTER (PM 10): El Paso County

FOR CARBON MONOXIDE: Section of El Paso County

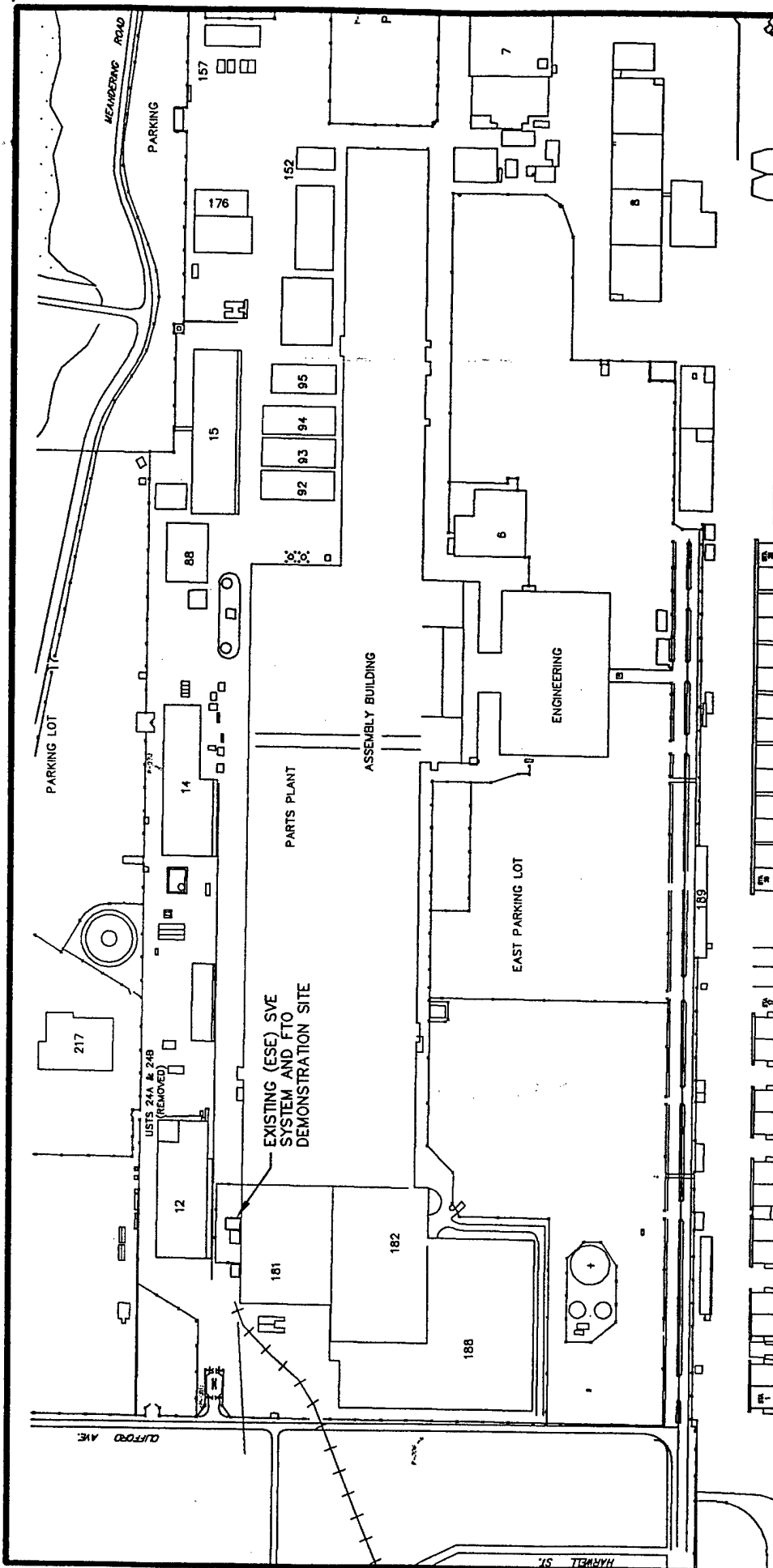


FIGURE II.A

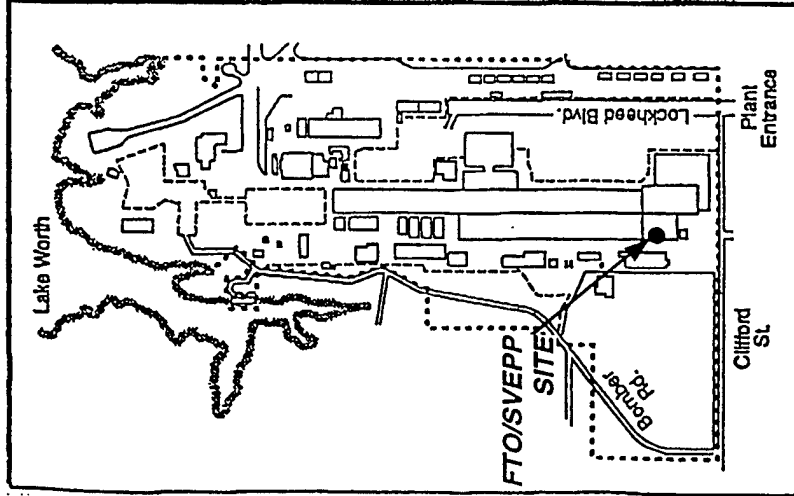
PLOT PLAN

FTO Demonstration
Air Force Plant 4
Fort Worth, Texas



**PARSONS
ENGINEERING SCIENCE, INC.**

Denver, Colorado



United States Air Force Plant No. 4
Lockheed Fort Worth Company

..... Property Boundary
----- Security Fence

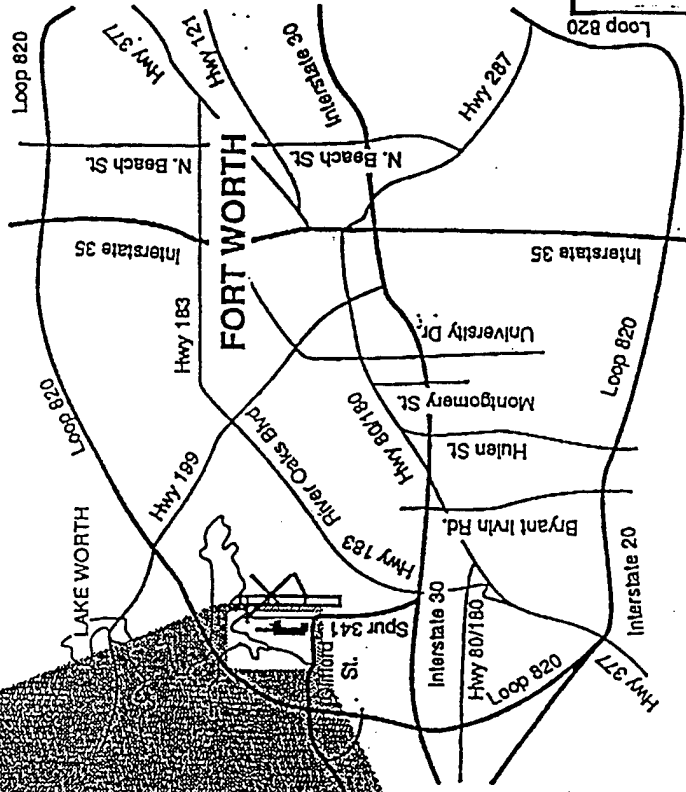
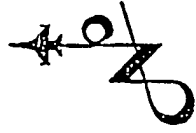


FIGURE II.B

AREA MAP

FTO Demonstration
Air Force Plant 4
Fort Worth, Texas



**PARSONS
ENGINEERING SCIENCE, INC.**

Denver, Colorado

Sources: LOCKHEED.

**FORM PI-7
(CONTINUED)**

SECTION IV PROCESS INFORMATION

The Air Force Center for Environmental Excellence (AFCEE) has contracted Parsons Engineering Science, Inc. (Parsons ES) to provide services that will support environmental air conformity through evaluation of the flameless thermal oxidation (FTO) vapor-phase treatment technology for off-gas abatement at various Air Force base sites worldwide. As prime contractor, Parsons ES has subcontracted Theramatrix, Inc. to provide the FTO treatment system. Currently, four Air Force installations have been identified as test sites for the FTO demonstrations, including Air Force Plant 4 (AFP 4), in Fort Worth, Texas.

The site selected for performance of the FTO demonstration at AFP 4 is Building 181. The soils beneath Building 181 are contaminated with trichloroethene (TCE) as a result of a surface release. Currently the U.S. Army Corps of Engineers (USACE) is operating a soil vapor extraction pilot plant (SVEPP) and groundwater treatment project (GTP) at this site. USACE has contracted International Technology Corporation (ITC) to operate these systems at Building 181 under an existing facility authorization of Standard Exemption No. 68, Registration No. 23558.

The FTO demonstration at Building 181 will include the installation of the Theramatrix FTO system, connection to existing vapor treatment system piping, startup testing, and a 90-day period of operation and performance monitoring. Additionally, several influent and effluent soil vapor samples will be collected during the startup and optimization period to evaluate the system performance during non steady-state conditions. Most of these samples will be analyzed in the field for the total organic vapor (TOV) content using a hand-held direct-reading instrument (photoionization

**FORM PI-7
(Continued)**

detector [PID] or similar). Several confirmatory samples will be shipped to a US Environmental Protection Agency (EPA) -certified air analytical laboratory for volatile organic compound (VOC) analysis using EPA Method TO-14.

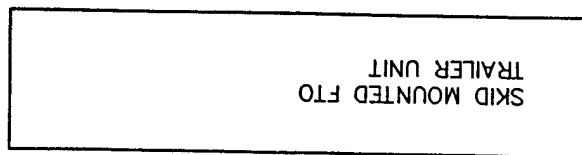
The process flow diagram of the FTO system is shown in Figures IV.A and IV.B. The FTO system will induce a vacuum to each of the vapor extraction wells (EWs) beneath Building 181 and convey the extracted TCE-laden vapors to the FTO system.

The FTO system is designed to extract and treat contaminated vapor at flow rates between 20 and 120 standard cubic feet per minute (scfm), and produce an effluent that reduces the influent contaminant concentration by not less than 99.99 percent. Vacuum is produced in the subsurface via a series of screened manifolds using an extraction blower. Extracted soil vapors are then injected at a regulated flow rate into a premixing chamber, then into the reaction bed. The FTO system also has a nominal residence time of 1.0 second, at a worst-case maximum inlet flow rate of 120 scfm.

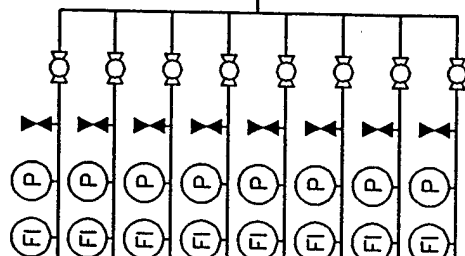
The system also contains an effluent quench and scrubber that will remove at least 99.5 percent of hydrogen chloride (HCl) from the reactor (oxidizer) exhaust during the maximum loading rate into the FTO system at 1,500 parts per million by volume (ppmv) (TCE) and 120 scfm. Two scrubber tanks are placed in series. The process is shown in the process and instrumentation diagram (P&ID) presented in Figures IV.C and IV.D.

The Thermatrix FTO system satisfies the requirements of Standard Exemption No. 68. Below is the response to each condition of this standard exemption.

- 68(a) The soil and groundwater contamination are believed to be from vapor degreasing tanks (since removed) in Building 181. No water or soil from outside the plant will be treated in these projects.



MANIFOLD
SAMPLE PORTS



INFLUENT
CONTROL
VALVE

LEGEND

- BALL VALVE
- ▶ SAMPLE PORT
- (P) PRESSURE (MAGNETIC)
- (FI) FLOW INDICATOR

NOTE:
DETAILS OF FTO SYSTEM PRESENTED IN
FIGURES IV.C AND IV.D

FIGURE IV.B PROCESS FLOW DIAGRAM (FTO TIE-IN TO EXISTING SVEPP PIPING)

FTO Demonstration
Air Force Plant 4
Fort Worth, Texas



**PARSONS
ENGINEERING SCIENCE, INC.**

Denver, Colorado

SOURCE: ESE, 1994b

INDUSTRIAL ACCESS ROAD

FTO TRAILER UNIT

VAPOR LINE TIE-IN

WATER TIE-IN

ELECTRICAL PANEL

FTO TRAILER UNIT

WATER TIE-IN

ELECTRICAL PANEL

WATER TIE-IN

FTO TRAILER UNIT

WATER TIE-IN

ELECTRICAL PANEL

WATER TIE-IN

FTO TRAILER UNIT

WATER TIE-IN

ELECTRICAL PANEL

WATER TIE-IN

FTO TRAILER UNIT

WATER TIE-IN

ELECTRICAL PANEL

WATER TIE-IN

LEGEND

- UZ-1 DEEP EXTRACTION WELL
- PZ-1 SHALLOW (PERCH ZONE) EXTRACTION WELL
- OW-1 OBSERVATION WELL
- VW-4 PERCHED ZONE MONITORING WELL
- MW-6 MONITORING WELL
- ▲ SG-18 SHALLOW SOIL GAS MONITORING PROBE
- SVEPP SYSTEM PIPING (PERMANENT 2 INCH DIA FIBERGLASS)
- - - FTO DEMONSTRATION PIPING

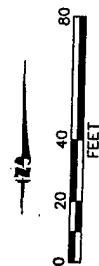


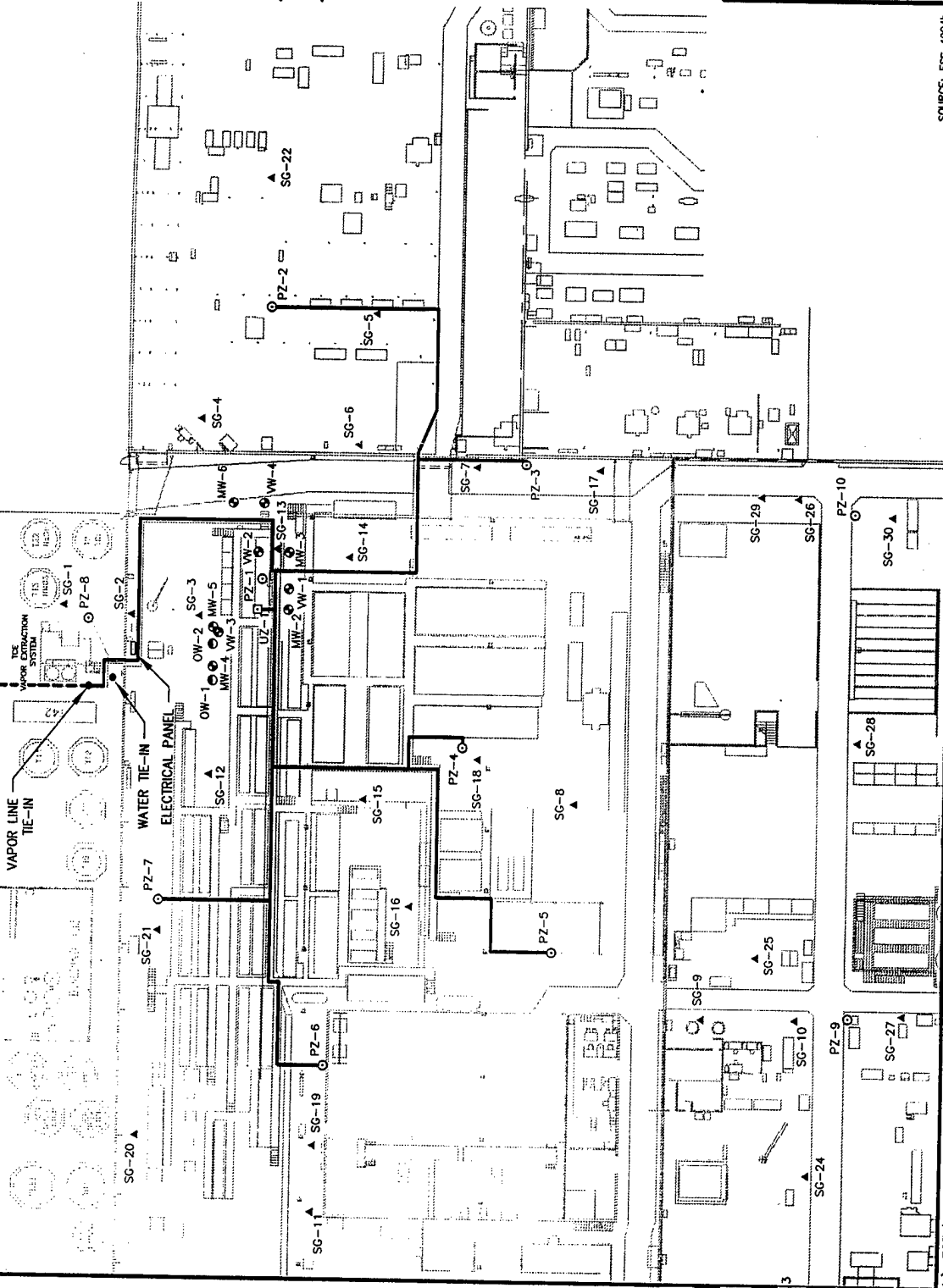
FIGURE IV.A

PROCESS FLOW DIAGRAM
(SVEPP LAYOUT
FTO TRAILER UNIT)

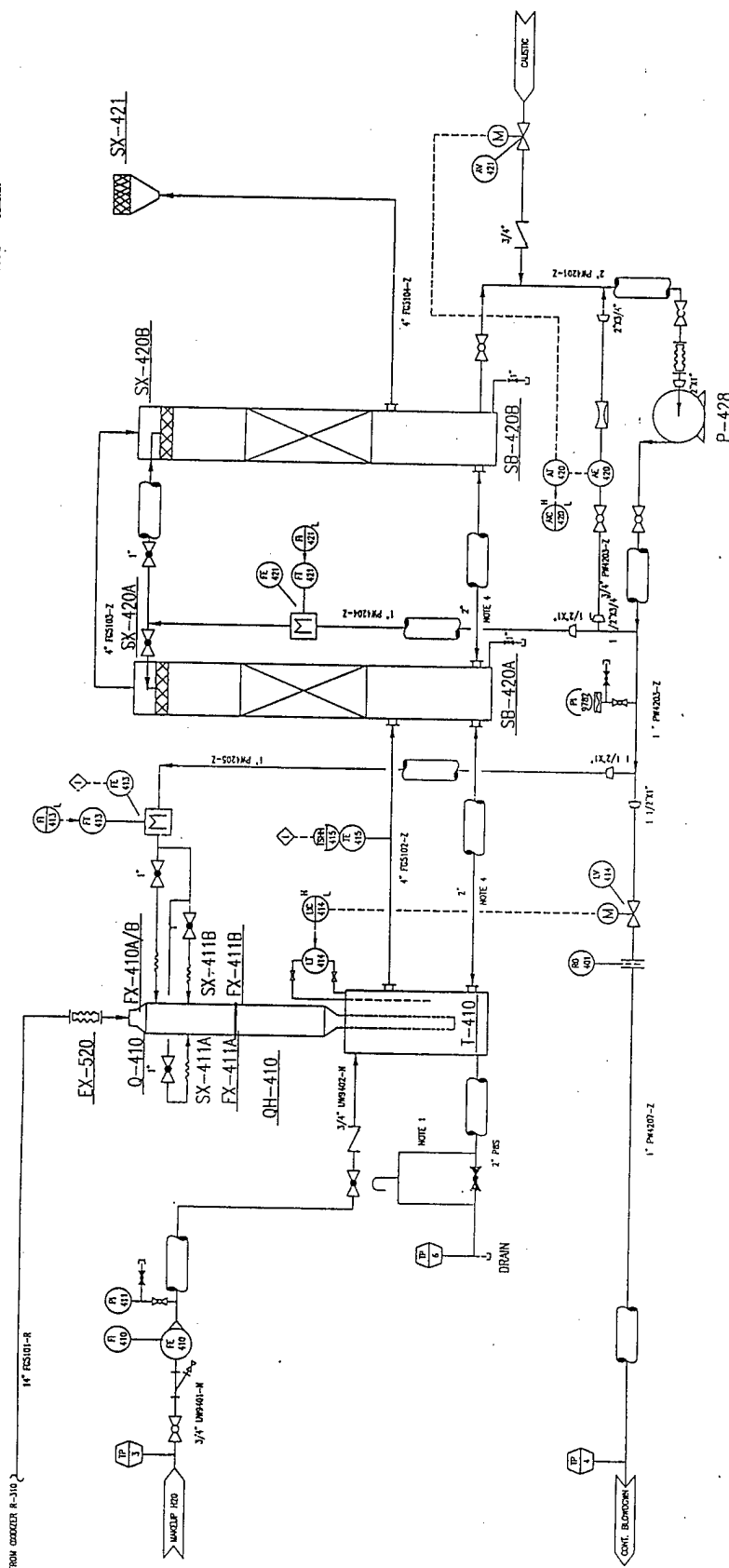
FTO Demonstration
Air Force Plant 4
Fort Worth, Texas

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

SOURCE: ESC 1994b



I-410 GUNCH TANK
 SX-411A GUNCH NOZZLE
 EX-520 EXPANSION JOINT
 Q-410 GUNCH WKB
 EX-411A FLEX CONNECTOR
 FX-411B FLEX CONNECTOR
 GUNCH NOZZLE
 SX-410A/B FLEX CONNECTOR
 QH-410 GUNCH DUCT
 SB-420A SOURCE
 SB-420B SOURCE
 SX-420B SPAY DISTRIBUTOR
 P-428 REGULATOR
 SX-421 REACTOR



Not to Scale

FIGURE IV.D

PIPING AND INSTRUMENTATION DIAGRAM BACK HALF FTO SYSTEM

FTO Demonstration
 Air Force Plant 4
 Fort Worth, Texas



PARSONS
ENGINEERING SCIENCE, INC.
 Denver, Colorado

NOTES

1. SX, LGS OVERLAPS AT HIGH LEVEL.
2. INSTRUMENT AIR IS NOT AVAILABLE.
3. STATUS OF ALL SWITCHES IS INDICATED.
4. COMMON SUPPLY LINE.

FORM PI-7
(Continued)

analyzed for VOCs using EPA Method TO-14 (includes both chlorinated and nonchlorinated VOCs). This sampling event will occur every 2 weeks during the 90-day evaluation period. Records of the oxidizer performance will be maintained in accordance with condition (g) of this exemption.

- 68(f) A copy of the Form PI-7 for the FTO demonstration will be sent to the TNRCC Office of Air Quality in Austin, Texas. Specific information concerning the basis of the expected emissions can be found in Section V
- 68(g) A copy of this form PI-7 and supporting data will be maintained at the site. These records will be available for inspection and retained for at least 2 years following the date the data was obtained.

**FORM PI-7
(CONTINUED)**

SECTION V EMISSIONS DATA

During an initial site visit in November 1995, a soil gas sample was collected from the source area within Building 181. This sample was collected in order to prepare the site-specific work plan and to provide the emissions data required for this standard exemption and to support the demonstration of the FTO system. As discussed with Mr. Terry Murphy of the TNRCC, the current emission points and off-plant receptor distances being used under the existing Standard Exemption Registration No. 23558 for this site would be applicable. The explanation of the estimated emission rates are presented herein.

The EWs to be used for the FTO demonstration are located within the vicinity of the former TCE degreasing tank area in Building 181. The soil gas sample collected in November 1995, was from EW UZ-1 located within the source area of the TCE contamination inside Building 181. Although there are an additional seven EWs as part of the existing extraction system, the soil gas sample was collected from the EW that showed the highest TCE contaminant levels based on the previous SVE pilot tests at this site. Laboratory analyses from the soil gas sample collected from UZ-1 in November 1995 detected only TCE at a concentration of 23,000 ppmv. To be conservative, the highest inlet concentrations at the highest inlet design flow rate were chosen to predict a worst-case scenario emission rate. The maximum inlet flow rate through the system is 120 scfm. The maximum designed loading rate is 3.67 pounds per hour (lb/hr) TCE. This inlet loading rate is equal to 1,500 ppmv TCE at 120 scfm. Likewise, an equal loading rate that may be considered could be 3,000 ppmv TCE at

**FORM PI-7
(Continued)**

60 scfm. During this demonstration, the total maximum loading rates into the FTO system will not exceed 3.67 lb/hr during any test condition. This will be ensured by monitoring the influent concentration and adjusting the flow rate and/or adding dilution air.

The maximum allowable emission rate, E, was calculated by the equation $E=L/K$, where L is determined from Table 118A, and K is a function of the distance from the emission point to the nearest off-plant receptor. For this project, the distance is 880 feet, which leads to a K value of 40.4.

A worst-case scenario was used to calculate the projected air emissions before treatment (E_p): 1) maximum air flow rate, 2) maximum concentration of contaminants, and 3) all of the VOCs are released to the atmosphere. The E_p value for TCE was calculated as follows:

Example: TCE = 1,500 ppmv

Convert ppmv to $\mu\text{g/L}$:

$$\mu\text{g/L} = [1,500\text{ppmv}] \div [24.055(\text{Ideal Gas Law})] \times [131.4 \text{ mol wt}=\text{TCE}]$$

$$\mu\text{g/L} = 8,194 \text{ TCE}$$

$$E_p = \left[8,194 \frac{\mu\text{g}}{\text{L}} \right] \times \left[120 \frac{\text{ft}^3}{\text{min}} \right] \times \left[28.3 \frac{\text{L}}{\text{ft}^3} \right] \times \left[60 \frac{\text{min}}{\text{hr}} \right] \times \left[10^{-9} \frac{\text{kg}}{\mu\text{g}} \right] \times \left[2.2 \frac{\text{lb}}{\text{kg}} \right]$$

$$E_p = 3.67 \text{ lb TCE/hr}$$

The FTO system is designed to provide greater than 99-percent destruction efficiency. The projected emission rate E_p for TCE was multiplied by 1.0 percent to determine the maximum projected emission rate, E_t for TCE, after FTO treatment. The resultant emission rate for TCE is provided in the table below. This table summarizes the contaminant, the maximum expected concentration (C), the L value for TCE from 118(c), corresponding maximum allowable emission rate (E), the projected

**FORM PI-7
(Continued)**

emission rate with no FTO treatment (E_p), and the projected emission rate (E_t) after FTO treatment. The projected emission rate after FTO treatment is below the maximum allowable emission rate for TCE.

SUMMARY OF FTO EMISSION RATE FOR TCE

Contaminant	C (mg/L)	L (Table 118A)	E (lb/hr)	E_p (lb/hr)	E_t (lb/hr)
Trichloroethene (TCE)	8,194	135	3.34	3.67	0.04

Since the FTO process converts TCE to CO_2 , H_2O , and HCl , the FTO system is equipped with a scrubber to remove the HCl produced during the oxidation process. Based on the calculated maximum loading rate of TCE at 3.67 lb/hr, the FTO system is designed to remove 99.5 percent of the HCl produced at this influent TCE loading rate. Assuming all chlorine turns to HCl , the following calculations provide the basis for meeting the maximum allowable HCl emission limit listed in Table 118A.

Example:

Convert TCE 3.67 lb/hr to lb mols/hr:

$$= 3.67 \text{ lb / hr} \Rightarrow \frac{3.67 \text{ lb / hr}}{131.4 \text{ mol wt / TCE}} = 0.028 \text{ lb mols / hr}$$

Convert TCE to HCl lb mols/hr:

$$[0.028 \text{ TCE mols/hr}] \times [3 \text{ Cl}] = 0.084 \text{ lb mols/hr HCl}$$

Convert HCl lb mols/hr to lb/hr:

$$[0.084 \text{ lb mols/hr}] \times [36.46 \text{ mol wt/HCl}] = 3.063 \text{ lb/hr HCl}$$

The FTO scrubber system is designed to remove 99.5 percent of the HCl at this maximum inlet loading rate of 3.063 lb/hr. The projected emission rate, E_p for HCl ,

**FORM PI-7
(Continued)**

was multiplied by 0.5 percent to determine the maximum projected emission rate, Et for HCl, after the FTO scrubber treatment. The resultant emission rate for HCl is provided in the table below. This table summarizes the contaminant, the maximum expected emission rate without FTO treatment (Ep), the L value for HCl from 118(c), corresponding maximum allowable emission rate (E), and the project emission rate (Et) after FTO scrubber treatment. The projected emission rate after FTO treatment is below the maximum allowable emission rate for HCl.

SUMMARY OF FTO EMISSION RATE FOR HCl

Contaminant	L (Table 118A)	E (lb/hr)	Ep (lb/hr)	Et (lb/hr)
Hydrogen chloride (HCl)	1.0	0.0247	3.063	0.016

Using this worst-case scenario for the FTO system demonstration, all projected contaminant effluent concentrations are below the applicable standard exemption maximum allowable limitations. To confirm these projections, scrubber efficiency will be verified during this demonstration by analyzing effluent vapor samples using the National Institute for Occupational Safety and Health (NIOSH) Analytical Method 7903 for HCl.

Barry R. McBee, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
John M. Baker, *Commissioner*
Dan Pearson, *Executive Director*



TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

February 1, 1996

Mr. Peter Guest
Project Manager
PARSONS ENGINEERING
SCIENCE, INC.
1700 Broadway, Suite 900
Denver, Colorado 80290

Re: Standard Exemption
Registration No. 31620
Flameless Thermal Oxidizer
Fort Worth, Tarrant County
Account ID No. TA-0156-K

Dear Mr. Guest:

This is in response to your exemption registration, Form PI-7, concerning the proposed installation of a flameless thermal oxidizer at your soil and groundwater remediation pilot facility at Air Force Plant No. 4 in Fort Worth, Tarrant County. We understand that the unit will be operational for only 90 days augmenting the existing soil vapor extraction system, and that estimated emissions of trichloroethene and HCl are 0.04 and 0.016 lb/hr respectively.

After evaluation of the information which you have furnished, we have determined that your proposed installation is exempt from permitting procedures under Standard Exemption Nos. 68 and 118 if constructed and operated as described in your registration request. These standard exemptions were authorized by the Executive Director of the Texas Natural Resource Conservation Commission (TNRCC) pursuant to Section 116.211 (Regulation VI). Copies of the exemptions in effect at the time of this registration are enclosed. You must operate in accordance with all requirements of the enclosed standard exemptions.

You are reminded that regardless of whether a permit is required, these facilities must be in compliance with all rules and regulations of the TNRCC and of the U.S. Environmental Protection Agency at all times.

Your cooperation in this matter is appreciated. If you have any questions concerning this exemption, please contact Mr. Duncan Stewart of our Office of Air Quality, New Source Review Division at (512) 239-1906.

Sincerely,

A handwritten signature in dark ink, appearing to read "T. Villarreal".

Tammy Villarreal
Manager, Chemical Section
New Source Review Division

TV/DS/ds

Enclosures

cc: Mr. Jesse Macias, Air Program Manager, Arlington
Mr. T. C. Michael, Acting Coordinator of Air Pollution Control Program, Department of
Environmental Management, Fort Worth

Record No. 41086

**FORM PI-7
(Continued)**

- 68(b) See Section V for an explanation of soil vapor contaminant analyses. The soil gas samples taken beneath Building 181 did not demonstrate any evidence of petroleum hydrocarbon contamination.
- 68(c) The FTO system emissions meet the requirements of Standard Exemption 118 (b), (c), and (d). (See Section V for explanation)
- 68(d) This project will not involve the handling or processing of contaminated soil or remediated soil, therefore, this requirements does not apply.
- 68(e)(3) The FTO system falls into this category of catalytic oxidizers according to telephone conversations with Mr. Terry Murphy (December 1995) of the Texas Natural Resource Conservation Commission (TNRCC) after his review of the system process. The FTO system is designed to achieve greater than 99 percent removal efficiency and typically as high as 99.99 percent. The FTO system is designed with several fail-safe shutdown modes. One fail-safe in particular, is tied into the operating temperatures of the system. The FTO system is designed to operate at 1,800 degrees Fahrenheit (°F), although, if the oxidizer (reactor) temperatures either fall below 1,400 °F or reach 2,200 °F, the system will automatically shut down. This feature ensures that the system will always achieve its designed removal efficiency. Due to this inherent feature of the FTO design, Mr. Terry Murphy (TNRCC) has waived the need to conduct weekly instrument readings using either a flame or photoionization detector or equivalent instrument to collect inlet and outlet samples from the system. However, as part of the FTO evaluation, the system will be sampled at the inlet and outlet using a portable direct-reading instrument similar to those mentioned, as well as the collection of laboratory samples from these same areas that will be

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

STANDARD EXEMPTION LIST

30 TAC §116.211
Control of Air Pollution By Permits For
New Construction or Modification

Adopted September 6, 1995
Effective October 4, 1995

68. Equipment used to reclaim or destroy chemicals removed from contaminated ground water, contaminated water condensate in tank and pipeline systems, or contaminated soil, for the purpose of remedial action, provided all the following conditions are satisfied:
- (a) Applicability shall pertain to soil and water remediation at the property where the original contamination of the ground water or soil occurred or at a nearby property secondarily affected by the contamination, but not to any soil or water treatment facility where soils or water are brought in from another property. Such facilities are subject to §116.1, relating to Permit Requirements.
 - (b) For treating groundwater or soil contaminated with petroleum compounds, the total emissions of petroleum hydrocarbons shall not exceed 1.0 pound per hour (lb/hr), except that benzene emissions also must meet the conditions of Standard Exemption 118(c) and (d). For purposes of this exemption, petroleum is considered to include: (1) liquids or gases produced from natural formations of crude oil, tar sands, shale, coal and natural gas, or (2) refinery fuel products to include fuel additives.
 - (c) For treating groundwater or soil contaminated with chemicals other than petroleum, emissions must meet the requirements of Standard Exemption 118(b), (c), and (d). If the groundwater or soil is contaminated with both petroleum and other chemicals, the petroleum compound emissions must meet condition (b) of this exemption and the other chemical emissions must meet the requirements of Standard Exemption 118(b), (c), and (d). The emission of any chemical not having a Limit (L) Value in Table 118A of Standard Exemption 118 is limited to 1.0 lb/hr.
 - (d) The handling and processing (screening, crushing, etc.) of contaminated soil and the handling and conditioning (adding moisture) of remediated soil shall be controlled such that there are no visible emissions with the exception of moisture.
 - (e) If abatement equipment is used to meet conditions (b) and (c), the equipment must satisfy one of the following conditions:
 - (1) The vapors shall be burned in a direct-flame combustion device (incinerator, furnace, boiler, heater, or other enclosed direct-flame device) operated in compliance with Standard Exemption 88(b) and (c).
 - (2) The vapors shall be burned in a flare which meets the requirements of Standard Exemption 80 and the requirements of 40 Code of Federal Regulations 60.18 which shall take precedence over Standard Exemption 80 in any conflicting requirements whether or not New Source Performance Standards apply to the flare.
 - (3) The vapors shall be burned in a catalytic oxidizer which destroys at least 90% of the vapors. An evaluation of oxidizer effectiveness shall be made at least weekly using a portable flame or photoionization detector or equivalent instrument to determine the quantity of carbon compounds in the inlet and outlet of the catalytic oxidizer. Records of oxidizer performance shall be maintained in accordance with condition (g).
 - (4) The vapors shall be routed through a carbon adsorption system (CAS) consisting of at least two activated carbon canisters that are connected in series. The system shall meet the following additional requirements:

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

STANDARD EXEMPTION LIST

30 TAC §116.211
Control of Air Pollution By Permits For
New Construction or Modification

Adopted September 6, 1995
Effective October 4, 1995

118. Facilities, or physical or operational changes to a facility, provided that all of the following conditions are satisfied:

- (a) This exemption shall not be used to authorize construction or any change to a facility specifically authorized in another standard exemption, but not meeting the requirements of that exemption. However, once the requirements of a specific exemption are met, Exemption 118(c) and (d) may be used to qualify the use of other chemicals at the facility.
- (b) Emission points associated with the facilities or changes shall be located at least 100 feet from any off-plant receptor*.
- (c) New or increased emissions, including fugitives, of chemicals shall not be emitted in a quantity greater than five tons per year nor in a quantity greater than E as determined using the equation $E = L/K$ and the following table.

<u>D, Feet</u>	<u>K</u>	
100	326	E = maximum allowable hourly emission, and never to exceed 6 pounds per hour.
200	200	
300	139	
400	104	
500	81	L = value as listed or referenced in Table 118A.
600	65	
700	54	
800	46	
900	39	K = value from the table on this page. (interpolate intermediate values)
1,000	34	
2,000	14	D = distance to the nearest off-plant receptor.
3,000 or more	8	

- (d) Notification must be provided using Form PI-7 within 10 days following the installation or modification of the facilities. The notification shall include a description of the project, calculations, and data identifying specific chemical names, L values, D values, and a description of pollution control equipment, if any.
- (e) The facilities in which the following chemicals will be handled shall be located at least 300 feet from the nearest property line and 600 feet from any off-plant receptor and the cumulative amount of any of the following chemicals resulting from one or more authorizations under this exemption (but not including permit authorizations) shall not exceed 500 pounds on the plant property and all listed chemicals shall be handled only in unheated containers operated in compliance with the United States Department of Transportation regulations (49 Code of Federal Regulations Parts 171 through 178): acrolein, ammonia, arsine, boron trifluoride, bromine, carbon disulfide, chlorine, chlorine dioxide, chlorine trifluoride, chloroacetaldehyde, chloropicrin, chloroprene, diazomethane, diborane, dimethylhydrazine, ethyl mercaptan, fluorine, formaldehyde, hydrogen bromide, hydrogen chloride, hydrogen cyanide, hydrogen fluoride, hydrogen selenide, hydrogen sulfide, ketene, methylamine, methyl bromide, methylhydrazine, methyl isocyanate, methyl mercaptan, nickel carbonyl, nitric oxide, nitrogen dioxide, oxygen difluoride, ozone, pentaborane, perchloromethyl mercaptan, perchloryl fluoride, phosgene, phosphine, phosphorus trichloride, selenium hexafluoride, stibine, liquified

TABLE 118A
LIMIT VALUES (L) FOR USE WITH STANDARD EXEMPTION 118

Values included in this table represent screening levels for determining the applicability of Standard Exemption 118 and other standard exemptions using the Exemption 118 equation. The values are not to be interpreted as acceptable health effects values relative to the issuance of construction permits, special permits, or operating permits under 30 TAC Chapter 16.

<u>Compound</u>	<u>Limit (L)</u> <u>Milligrams Per Cubic Meter</u>	<u>Compound</u>	<u>Limit (L)</u> <u>Milligrams Per</u>
Acetone	590	Acetaldehyde	9
Acetone Cyanohydrin	4	Acetonitrile	34
Acetylene	2662	Adiponitrile	18
Aldrin	0.15	Sec-Amyl Acetate	1.1
Arsenic	0.01	Benzene	3
Beryllium and Compounds	0.0005	Butyl Acrylate	19
Butyl Glycidyl Ether	30	Butyl Mercaptan	0.3
Butyraldehyde	1.4	Butyric Acid	7.3
Butyronitrile	22	Carbon Tetrachloride	12
Chloroform	10	Chlorophenol	0.2
Chloroprene	3.6	Chromic Acid	0.05
Chromium and Compounds	0.025	Coal Tar Pitch Volatiles	0.1
Creosote	0.1	Cresol	0.12
Cumene	43	o-Dichlorobenzene	180
p-Dichlorobenzene	108	1,2-dichloroethylene	79
Dicyclopentadiene	3.1	Diethylaminoethanol	5.5
Diisobutyl Ketone	140	Dimethyl Aniline	6.4
Dimethylhydrazine	0.15	Dioxane	3.6
Dipropylamine	8.4	Ethyl Acrylate	0.5
Ethylene Dibromide	1	Ethylene Glycol Dinitrate	0.1
Ethylene Oxide	0.18	Ethyl Mercaptan	0.15
Ethyl Sulfide	1.6	Fibrous Glass Dust	5
Hexylonitrile	5	Heptane	350
Hydrazine	0.04	Hydrogen Chloride	1
Hydrogen Sulfide	1.1	Isoamyl Acetate	13

APPENDIX C

FTO SYSTEM
KNOXVILLE REPAIR AND MODIFICATIONS

THERMATRIX, INC.
308 N. Peters Rd., Suite 225
Knoxville, TN 37922

TELEFAX TRANSMITTAL

DATE: August 5, 1996

TO: Pete Guest
Parsons Engineering Science
FAX: (303) 831-8208FROM: Jeff Dasch
PHONE: (423) 539-9603
FAX: (423) 539-9643

SUBJECT: Thermal Oxidizer Knoxville Repair and Modifications

Per your request listed below is a summary of the operational issues and corrective actions that we have implemented since the thermal oxidizer was removed from Air Force Plant 4 to our fabrication and assembly shop here in Knoxville.

Issues We were unable operate the oxidizer system at total flow rates below 90 scfm. Two conditions caused this limitation. First, there was likely a 2-3 ft³ void in the ceramic media in the oxidizer vessel. While at Air Force Plant 4, the preheater was removed and ceramic balls and saddles were found to have fallen down from the vessel into the preheat burner. Secondly, the supplied Gast blower is designed to operate only at the higher rates.

Actions

Task #1 - The ceramic media was removed from the vessel and a brick retaining wall with 1" holes was installed to maintain the integrity of the media configuration. The media design was modified from the original to enhance the unit's turndown capabilities, i.e., the ball/saddle interface was moved to a lower level in the vessel.

Task #2 - Installed a variable frequency drive (VFD) to control the blower motor speed allowing it operate at the lower flow rates.

Task #3 - Ran the unit first with cold air and then at operating temperatures to test the range of total attainable flow.

Subsequent Issues In the new configuration oxidizer temperature control became problematic. At the lower flow rates the oxidation wave moved to the lower levels of the vessel. The upper temperature levels would drop to the point that they would trip the unit off.

There are six thermocouples in the oxidizer vessel, one controlling and five for indication. The controlling thermocouple, which determines the amount of fuel to be added to maintain temperature, is located nearest the oxidation front. As this wave moved lower in the vessel at the lower flow rates, it became necessary to move temperature control to a lower thermocouple.

Actions

Task #4 - The ceramic media was again removed and an additional 1" layer of ceramic blanket was installed for better temperature control. The ceramic media was reinstalled.

Task #5 - All thermocouples were rewired to the PLC. An additional output card and a control level selector were added to the PLC. The PLC program was modified to allow the system operator to set the controlling thermocouple based upon the fume flow rate. The low temperature shutdown logic was changed so that all thermocouples above the controlling thermocouple are scanned to ensure that at least

one temperature element is reading above the shutdown level. Thus, when operating at a low flow rate and the oxidizing wave is near the bottom of the vessel, a cold reading at the top of the oxidizer will not shut down the unit as long as there is sufficient temperature at a level above the controlling thermocouple.

Task #6 - The modifications made in Task #5 necessitated the addition of another temperature indicator in the control panel.

Additional Subsequent Issues After the above modifications were implemented and the unit tested at various flow rates between 30 and 120 scfm, it was found that the oxidation front was unstable. The wave tended to float down and into the inlet pipe. It was determined that the fume line flow element and its differential pressure cell were unable to accurately measure the low flows.

Action

Task #7 - The section of the fume line containing the flow elements was changed from 3" pipe to 2", creating a higher pressure across the flow element annubar. The differential pressure cell was recalibrated to provide the accurate flow signal.

Issue While running the unit at the site, there was considerable difficulty controlling the pH level whenever the caustic solution was added to the system. When the pH levels dropped to around 5.5, the added caustic would quickly drive it up to 11 or more. It was determined that the problem was created by a high concentration of caustic solution was being introduced to the system at a point very close to the pH analyzing element.

Actions

Task #8 - In the original configuration, caustic was introduced to the system by the opening of a valve on the line from the caustic storage tank and gravity fed to the quench water recycle pump intake line. The valve was replaced by a metering pump and a new caustic line was added from the metering pump to connect to the quench well and spray nozzle water lines. This allowed for increased mixing of the caustic solution with the quench/scrubbing water. The new lines were heat traced and insulated.

Task #9 - In the original configuration, the pH probe was located in a quench circulation pump bypass line. This probe was relocated to the bottom of the quench storage tank. This modification allowed for pH measurement at a location where much better mixing of caustic solution and quench/scrubber water occurs.

Subsequent Issues After the above modifications were implemented, the quench water temperatures would gradually rise to high levels and trip the unit off. Additionally, at high fume flow rates the pressure created in the quench tank discharge caused water to flow out of the overflow seal leg.

Actions

Task #10 - New spray nozzles with larger discharge openings were installed in the quench duct.

Task #11 - The height of the overflow seal leg was increased.

Issue The quench/scrubber recirculation pump was found to be misaligned and the coupling sleeve significantly worn.

Action

Task #12 - The pump coupling was replaced and the pump realigned.

Issue A small crack was found on the 10" x 4" reducers on each scrubber.

Action

Task #13 - The reducers were discarded as a result of the modifications made in Task #12. ^{4/13/96}

Issue When completely assembled, the scrubber and stack heights exceed the 13'6" height restriction for unpermitted transport.

Action

Task #14 - The scrubber crossover duct and reducers were removed from the top of the scrubbers bringing their height down to the desired level. Each scrubber top was capped. A horizontal duct between the scrubbers was installed just below the top of each. The stack was shortened to the desired height.

Issue When the basket strainer was added to the system, the supports were not secured to the skid.

Action

Task #15 - The basket strainer supports were welded to the skid.

Issue During operation the uninterruptible power supply (UPS) rattled.

Action

Task #16 - The UPS support bracket was resecured.

After all of the above tasks were completed, the unit was tested at various total flow rates and varying levels of TCE gas introduced to simulate field operations. These tests were witnessed by Mr. Steve Archabal during his visit to our facility on July 27 - 29th. The system functioned properly during all phases of the testing.
20-22 p.m.

Mr. Archabal also requested two additional items added to this unit.

Issue Fume concentrations cannot be measured prior to oxidation.

Action

Task #17 - A sample port was installed in the fume line downstream from the mixer.

Issue When the quench/scrubber system is used for treating vapors containing chlorides, the unit runs in its GSC (Gas Straight-through for Chlorides) mode. When the quench/scrubber system is not required (GS mode), the exhaust duct to the quench is blocked and a flange on the top of the oxidizer is removed so that the exhaust is discharged straight up from the vessel. Should there be any precipitation while the unit is in operation, it will be vaporized at the exhaust point. However, should the unit go down and significant amount of moisture enter the vessel and wet the ceramic media, upon restart of the unit the media will shatter if it is wet enough.

Action

Task #18 - A rain hat to keep out precipitation was added for the GS operating mode.

cc: Chris Baer
File 3780.2.1